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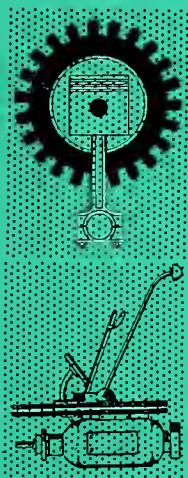


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# *Automotive Area*

OF

INDUSTRIAL ARTS INSTRUCTION IN  
PENNSYLVANIA PUBLIC SCHOOLS



## SUBJECT AREAS

Automotive  
Ceramics  
Electricity  
Graphic Arts  
Home Mechanics  
Metal Forming  
Metal Machining  
Planning  
Plastics  
Sheet Metal  
Textiles  
Woodworking

BULLETIN 331-A  
1953

COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF PUBLIC INSTRUCTION • Harrisburg

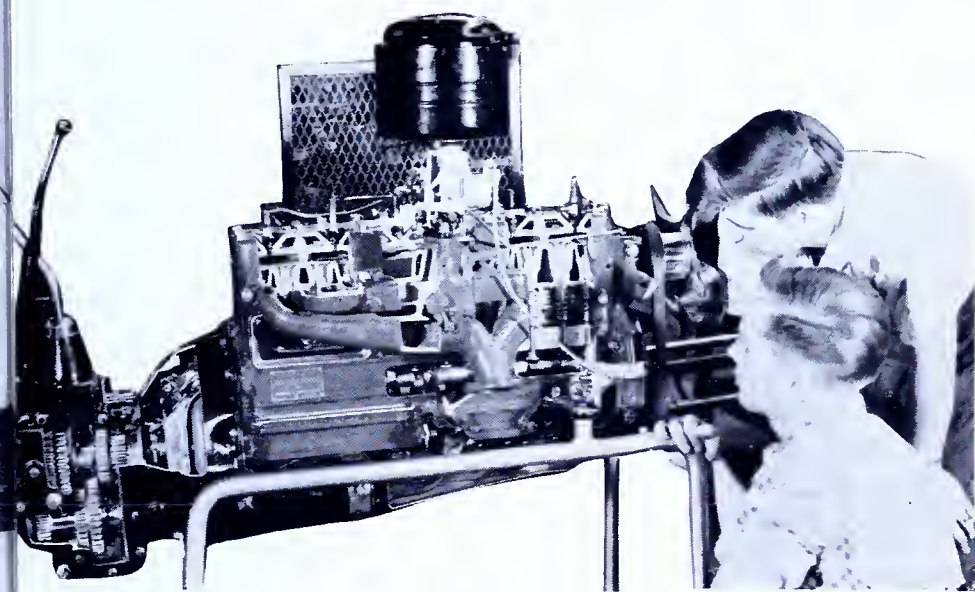




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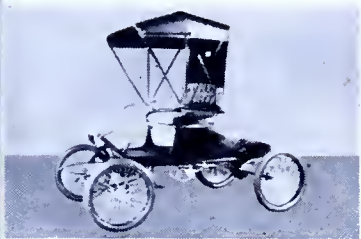
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**DEPARTMENT OF PUBLIC INSTRUCTION**

• **Harrisburg**

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## Foreword

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IN THE BROAD AREA OF INDUSTRIAL ARTS EDUCATION, attention is being directed to the Automotive Area of instruction which provides exploratory experience with tools and materials in many industrial activities and, at the same time, develops appreciations and understandings concerning the repair, reconditioning, adjustment, and maintenance of the automobile.

This is one in a series of bulletins on specific areas of instruction in the field of Industrial Arts Education. It provides detailed information pertaining to the Automotive Area of work in a comprehensive general shop. It supplements *Industrial Arts in Pennsylvania*, Bulletin 331, published in September 1951, by the Department of Public Instruction.

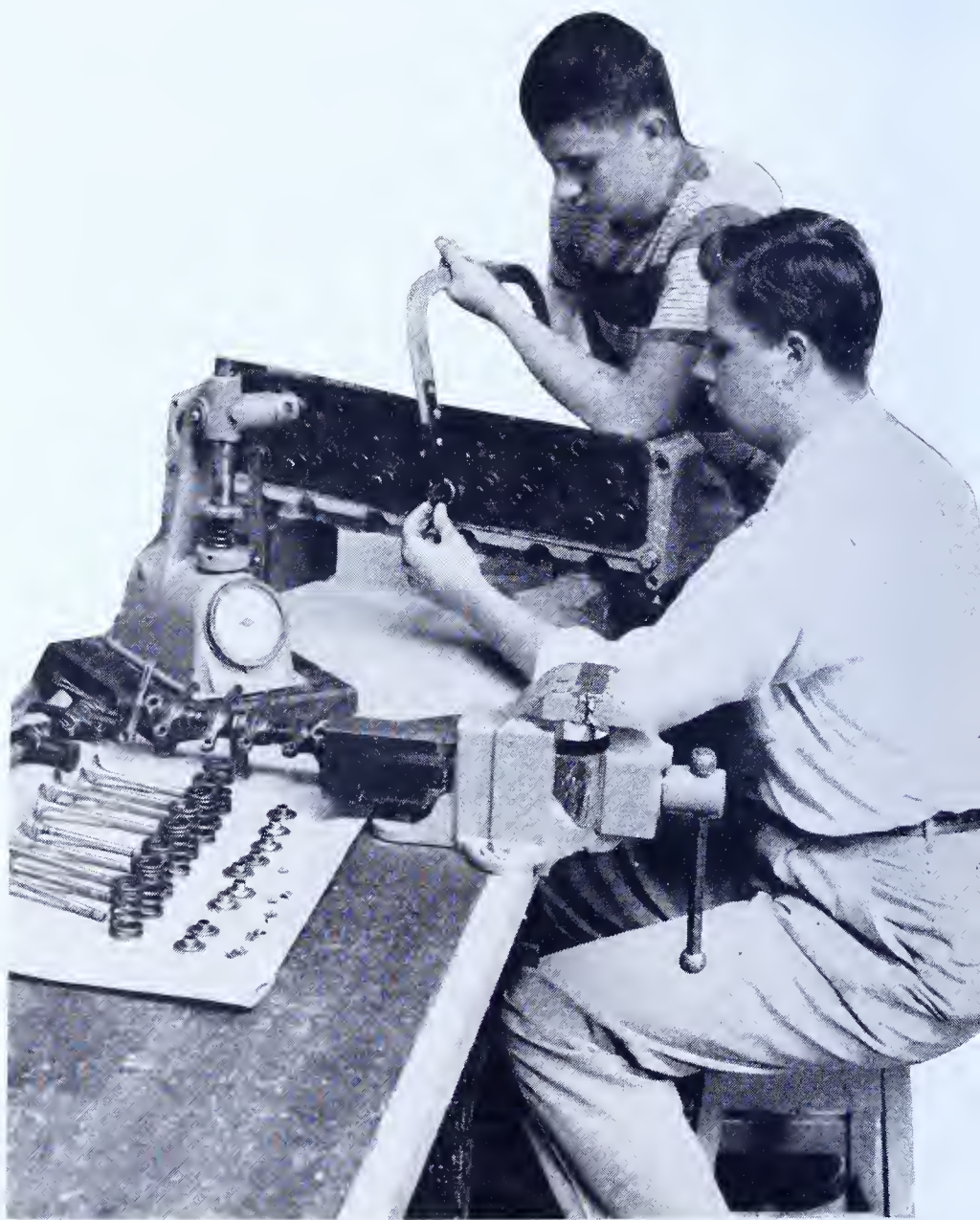
This bulletin was prepared by William L. Cooper, Senior Area Coordinator of Industrial Education and Ralph K. Beamer, Assistant Professor of Education, University of Pittsburgh, under the supervision of Robert T. Stoner, Chief, Trade and Industrial Education. Preliminary work on manuscript and layout planning was done by R. Randolph Karch, Adviser, Trade and Industrial Education.

This bulletin has been edited by Rachel S. Turner, Editor for the Department of Public Instruction.

*Francis B. Hoar*

*Superintendent of Public Instruction.*

JUNE 1953



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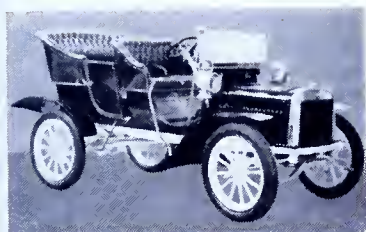
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# Introduction

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BECAUSE OF THE DIFFERENCES IN EDUCATION CONCEPTS, in backgrounds of the administrator and teacher, in variations in the time pupils spend in the activity, in amount of funds available for equipment and supplies, as well as in other factors, no attempt is made in this bulletin to set up a common course of study applicable to all situations, or to tell the teacher what to teach, how to teach, or what equipment he should have in his shop.

This bulletin does list in the "Things to Do" and "Things to Know" sections on pages 5 through 12 course content which may be selected by the teacher. These learning units also help to determine particular aims and objectives, amount of time available to pupils in the Automotive Area, and the necessary equipment.

Suggestions to guide the administrator are made on the organization of instruction, instructional material, devices, instruction sheets, and on the use of records and forms.

Included for further guidance are a selected annotated bibliography of readily available instructional materials and visual aids, a suggested inventory of equipment and supplies with their approximate cost, a feasible shop layout, and other information related to establishing or enriching the Automotive Area of a comprehensive general shop or of a unit (one activity) shop.

Matters pertaining to Industrial Arts in general are not discussed in this bulletin. For further information the reader is referred to Bulletin 331, *Industrial Arts in Pennsylvania*, published by the Department of Public Instruction, September 1951.





# *1 The Automotive Area*

## **AS AN INDUSTRIAL ARTS ACTIVITY**

THE UNDERLYING PHILOSOPHY of the Automotive Area is identical with that of Industrial Arts education since it provides experiences in a variety of industrial materials, processes, and services. It is an area of Industrial Arts education that provides information and practical experiences in automobile repair and maintenance. Attention is given to instruction that enables boys, girls, and adults to contribute directly toward the maintenance of their vehicles. Such knowledge develops confidence, self-reliance, pride in accomplishment, and also develops appreciations and understandings that have value in terms of family welfare and happiness.

The Automotive Area may be selected as one of the areas of Industrial Arts instruction forming an integral part of at least four activities in a comprehensive general Industrial Arts shop; or this area may be taught on a unit shop (one activity) basis.

Since most families own and operate at least one automobile, the school administrator and the Industrial Arts teacher will find that many pupils are interested in the Automotive Area.

### **Aims and Objectives**

If instruction is to be purposeful and is to provide the greatest contribution to the pupil, aims and objectives must be established and developed. Objectives are formulated in terms of the goals desired. They provide a basis for the choice of subject matter and serve as a means for the evaluation of progress in the subject. The determination of objectives is, therefore, the starting point in the development of this area of instruction.

Activities in the Automotive Area help pupils attain the broad general objectives of Industrial Arts education and provide experiences which assist in the development of the following more specific objectives:

1. Understanding concerning the proper use and elementary care of automotive equipment and a pride in ownership
2. Training necessary to enable the pupil to perform simple jobs connected with the upkeep and maintenance of automobiles in order to maintain their value at a saving of time and money
3. Instruction which will develop more intelligent purchasers and consumers of automobiles and accessories
4. Elementary skills in the use of tools and materials in a variety of industrial areas
5. An understanding and appreciation of a number of automotive occupational fields
6. Interest in a home workshop

### **Organization and Grade Levels**

The instructional program outlined for the Automotive Area represents maximum instructional possibilities, but selections can be made for the junior or senior high school level. The elementary phases may be offered in the junior high school grades and the more advanced phases may become a part of the senior high school program. Flexibility in this respect is possible because operation and jobs are independent of one another and need be followed only in a limited sequence. It is also possible to integrate and coordinate the work in the Automotive Area with that in the other areas of the comprehensive Industrial Arts shop.

Because of the variety of experiences involved and the practical nature of the Automotive Area, it is an excellent activity to offer in the ninth grade when the school receives many pupils who have had no previous Industrial Arts experience in the seventh and eighth grades. Moreover, if Industrial Arts is not offered at the senior high school level, the ninth is the only grade in which pupils have contact with Industrial Arts work.

Instruction in the Automotive Area is feasible for girls as well as boys. Because women also operate motor vehicles they should develop an understanding of the mechanics, technology, and proper maintenance of the automobile for more effective and intelligent use.

Areas of instruction have been selected which will best develop an understanding of the functions of the various parts of the auto



mobile and their care. It is hoped that this understanding will condition the usage which the individual will give the car and emphasize the need for proper maintenance.

Emphasis is placed upon “knowing the car” rather than “repairing the car,” although sufficient jobs are listed so that the pupils will develop an appreciation of a mechanic’s skills, and the knowledge necessary to service and repair a modern automobile adequately.

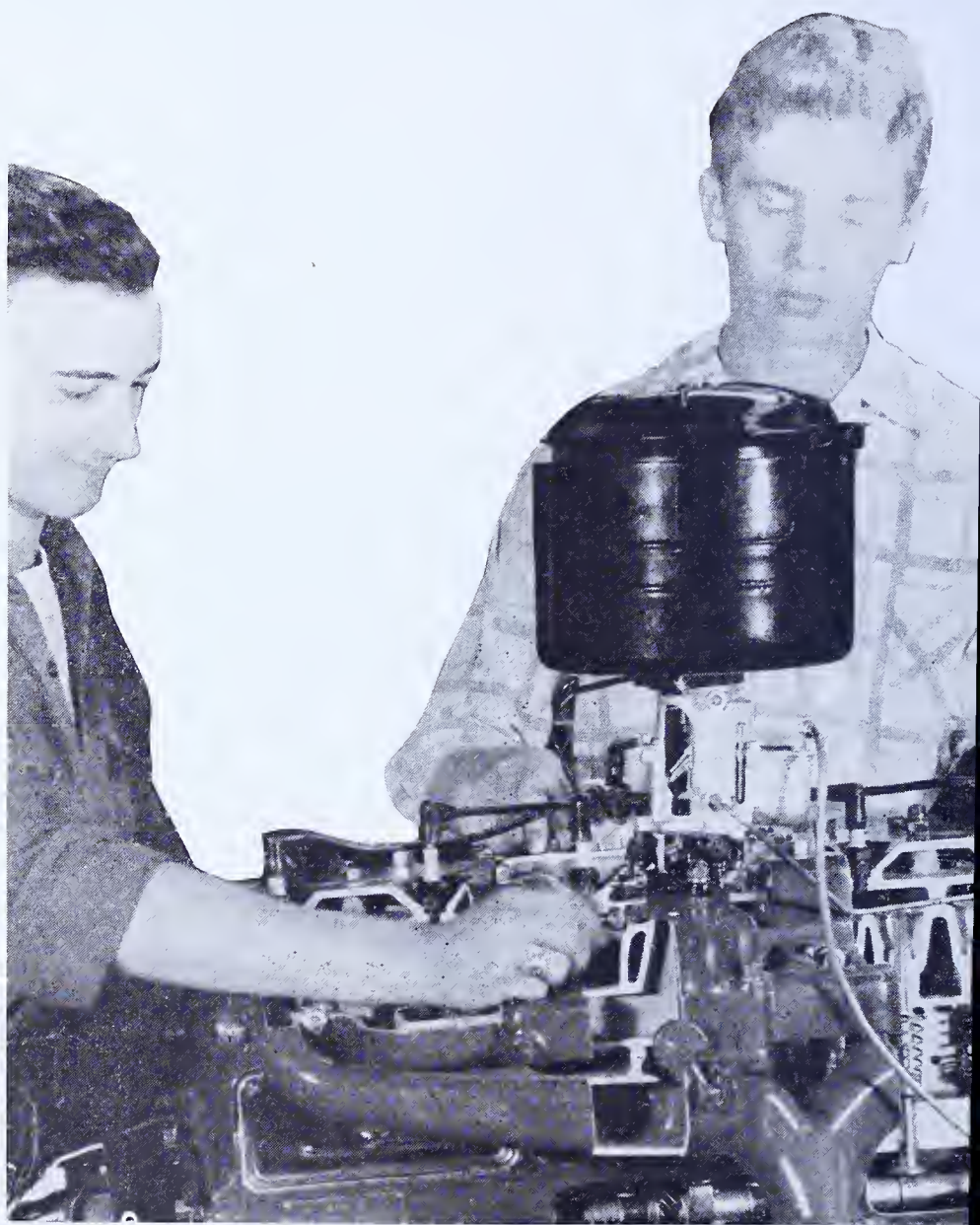
### **Tools, Materials, and Processes**

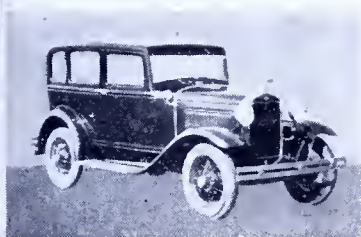
The underlying philosophy of Industrial Arts education is developed in the Automotive Area by providing opportunity for experience with many tools, operations, materials, and processes of industry. A wide variety of jobs should be used to meet the broad objectives of Industrial Arts and to provide the pupil with the media for desirable and needed experiences so that he can better fit into today’s complex society.

### **Occupations Allied to the Automotive Area**

Many high school pupils lack clear-cut objectives; therefore, proper occupational guidance in the secondary school program is very important. Acquiring a comprehensive view of occupational fields is an increasingly difficult task, since the problems of industry change so rapidly that it is difficult to keep pace with occupational changes. Young people, faced with the problem of choosing a vocation, naturally consider those fields of work with which they have had some contact or information. High school pupils’ range of vocational choice is limited to the restricted number of occupations known to them.

It is apparent that an important function of Industrial Arts education is to provide exploratory experiences and vocational information concerning occupational opportunities during the years when pupils are considering occupational choices.





## **2** *Learning Units*

### **THINGS TO DO AND THINGS TO KNOW**

THE SELECTION OF SUBJECT MATTER for an Industrial Arts activity is based on an analysis of the processes of industry. This analysis provides a list of the manipulative or practical learning units as well as informational content. Final selection of subject matter is based on those experiences which are representative and fundamental to the activity and which contribute toward the attainment of the objectives of the course. The result is a list of learning units which represent the things a pupil should be able to do and the things he should know.

The following analysis of the Automotive activity is based on what the average car owner or operator should know about the repair and maintenance of his car. The job assignments are classified according to "Things to Do" and "Things to Know" under the following units:

- A. Power Generation in an Automobile
- B. Power Flow in an Automobile
- C. Road Control of an Automobile

### **UNIT A. POWER GENERATION**

#### **THINGS TO DO**

1. Remove, examine, diagram, and replace a carburetor air cleaner

#### **THINGS TO KNOW**

- a. How cleaner removes dirt and dust from air
- b. How the cleaner muffles air noise
- c. How cleaner controls backfire flashes
- d. Why air must be cleaned

## THINGS TO DO

2. Trace and diagram the crank case ventilating system
3. Remove, examine, diagram, and replace an oil filter cartridge
4. Remove and replace a generator and adjust belt
5. Remove cover of voltage regulator, examine regulator, and replace cover
6. Remove, examine, and replace a starting motor
7. Remove, examine, diagram, and replace a water pump and trace flow of water in cooling system
8. Remove and replace an oil pan

## THINGS TO KNOW

- a. The need for ventilating the crank case
- b. Methods of ventilating crank-case
- a. Types of cartridges
- b. Filtering materials or methods
- c. Reasons for filtering engine oil
- a. Proper belt alignment and tensions
- b. Results of improper tension or alignment
- c. Importance of proper electrical connections
- a. Principles of electromagnetism
- b. Importance of voltage cutout
- c. How charging rate of generator is increased or decreased
- d. Importance of proper electrical connections
- a. Method of engaging starting motor to engine.
- b. How to diagram the electrical circuit for starting motor
- c. Reasons for use of heavy wire in starting circuit and starting motor
- d. Location and types of starting switch mechanisms
- a. Importance of water pump
- b. Why water is used as a cooling medium
- a. Purpose of oil pan
- b. Need for careful sealing
- c. Need for oil reservoir



## THINGS TO DO

9. Remove cover and gears from a gear-type oil pump; diagram the oil flow; test, and replace
10. Remove, examine, and replace cylinder head
11. Adjust valves on an "L" head engine; adjust valves on a valve-in-head engine
12. Determine the firing order of an engine by observing the order in which the valves open and close.
13. Make a timing valve diagram of an engine by studying its operation
14. Remove and replace the timing gear or the timing chain and time the valves according to the timing valve diagram (not by marks)

## THINGS TO KNOW

- a. How pump is driven
- b. How excessive oil pressure is relieved
- c. Reasons for low pressure
- a. Cylinder head materials and their characteristics
- b. Function, shape, and location of water passages
- c. Causes of excessive heating and the effect of sudden cooling
- d. Shape and size of the combustion chamber and its relation to compression ratio
- a. Method of identifying exhaust and intake valves
- b. Need for proper valve clearance
- c. Need for proper valve seating
- d. Need for proper spring tension
- e. Position of piston in the operating cycle when valves are to be adjusted
- a. Method of identifying exhaust and intake valves
- b. Normal direction of engine rotation
- a. Normal direction of engine rotation
- b. Identification of valves
- c. Names and order of the strokes in the operating cycle
- d. Method of dividing a circle into degrees
- a. How to read and construct a timing valve diagram
- b. How to identify the strokes in the operating cycle

## THINGS TO DO

15. Remove spark plug wires from ignition distributor cap; examine, and replace
16. Remove ignition points; replace and retune ignition; and diagram the ignition circuit
17. Remove, test, and replace ignition condenser and diagram it in circuit
18. Remove and replace primary ignition wires according to a circuit diagram and test for spark from coil
19. Remove, examine, adjust, replace, and test spark plugs
20. Examine and identify: (1) the idling circuit, (2) the high-speed circuit, and (3) the accelerating circuit of a disassembled carburetor

## THINGS TO KNOW

- a. How to determine the firing order of the engine
- b. Characteristics of high tension cables and high tension current
- c. Relation between distributor rotation and the firing order
- a. Purpose of the spark
- b. How the spark is produced at the spark plug
- c. When the spark should occur
- d. Effect of engine speed and engine vacuum on spark timing
- a. Purpose of the condenser
- b. Effect of defective condenser
- c. Principle of the condenser
- a. Importance of tight electrical connections
- b. Principle of induction
- c. How the high tension secondary current is related to coil windings
- a. Purpose of the plug
- b. Importance of proper gap settings
- c. Meaning of insulation
- d. Insulating materials
- e. Compression and its relation to spark requirements
- a. Need for reading cross-section diagrams of mechanical parts
- b. Need for understanding relation of (1) throttle position and (2) load on engine to carburetor circuits

## THINGS TO DO

## THINGS TO KNOW

- |   |  |
|---|--|
| 21. Remove and replace a storage battery and make proper cable connections                            | a. Reason for bare battery ground wires<br>b. Need for a good and complete ground circuit<br>c. Need for identifying and matching positive cables to positive posts of batteries and the same for negative cables and negative posts<br>d. Need for rubber apron to protect clothing |
| 22. Test one good and one poor storage battery with a breakdown tester and replace on battery charger | a. Effect of temperature on battery output<br>b. Effect of charge on battery output<br>c. Effect of plate area on battery output<br>d. Battery insulators and their purpose  |
| 23. Test a storage battery with a battery hydrometer  | a. Protective devices from battery acid<br>b. How strength of electrolyte indicates charge in battery<br>c. What specific gravity means  |
| 24. Check and adjust a carburetor float level; examine and diagram the float control mechanism        | a. Need for factory specifications<br>b. Effect of improper float levels   |
| 25. Diagram and connect the wires on a demonstration light panel                                      | a. Need for tight connections<br>b. Need for switches with good contacts<br>c. Need for proper ground connection or circuit return<br>d. Danger from short circuits<br>e. Difference between open circuits and short circuits  |

## THINGS TO DO

26. Remove, examine, and replace starting motor cables
27. Examine a hand-operated choke and an automatic choke; make a diagram showing how engine speed is increased while the engine is cold
28. Adjust the idling speed by means of the throttle and also by changing the mixture
29. Disassemble; make a cross-section diagram; reassemble; and check a fuel pump
30. Using a tester to test anti-freeze mixtures with various percentages of antifreeze
31. Test the temperature operation of two bellows-type thermostats with different temperature openings and one bimetallic thermostat
32. Remove; test for opening; and replace a thermostat and top water hose
33. Trace and diagram the exhaust flow through a cutaway muffler

## THINGS TO KNOW

- a. Battery cable electrical load requirements
- b. Importance of clean and tight connections
- a. Need for the choking mechanism
- b. Principle of automatic chokes
- c. Effect or symptoms of over-choking and under-choking
- d. Need for air in the gasoline mixture
- a. Need for study of exact factory specifications and directions
- a. Principle of automatic pressure regulation
- b. Principles of check valves
- c. Principles of vacuum applied to the pumping of liquids
- a. Specific gravity of liquid mixtures
- b. Freezing points of various solutions
- c. Need for protection from freezing
- a. Boiling points of water and of antifreeze mixtures
- b. Low boiling liquids for bellows-type thermostats
- c. Principles of bimetallic temperature-operated controls
- a. Location of thermostat
- b. Purpose of thermostat
- c. Sizes of water hose
- d. Types of hose clamps
- a. Purpose of muffler
- b. Danger from a broken or a leaking muffler

## UNIT B. POWER FLOW

### THINGS TO DO

1. Adjust a clutch pedal
2. Examine a sliding gear-type transmission and diagram the power flow in the various speeds
3. Examine a differential assembly and calculate the rear axle gear ratio

### THINGS TO KNOW

- a. Purpose of the clutch
- b. Principle of levers
- c. Damage from a tight pedal with no play
- a. Purpose of the transmission
- b. Ratio of gears for speed and for power
- a. How to calculate gear ratios
- b. Principle of the differential which allows one rear wheel to travel faster than the other



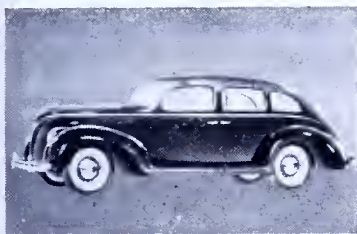


## UNIT C. ROAD CONTROL

### THINGS TO DO

### THINGS TO KNOW

- |  |   |
|--|---|
| 1. Examine, adjust, and diagram the action of the hydraulic brake setup with cut-away drum | a. Principle of hydraulics<br>b. Principle of levers<br>c. Self-energizing action applied to brakes<br>d. Effect of air in the hydraulic brake system   |
| 2. Remove, replace, and adjust a front wheel bearing                                       | a. Types of front wheel bearings<br>b. Importance of factory directions relative to adjustment of front wheel bearings<br>c. Need for extreme care in the use of locking devices              |
| 3. Examine, note adjustments, and calculate the ratio of a cutaway steering gear           | a. How to estimate degrees in fractional parts of one revolution ( $360^\circ$ )<br>b. How to estimate gear ratios by noting relation of the revolutions of the driving to the driven members |
| 4. Adjust toe-in by measurement  | a. Importance of wheel alignment<br>b. The relation of tire scuffing to tire wear   |
| 5. Deflate, remove, examine, replace, and inflate a tire                                   | a. Need for care when handling items containing air or gas under great pressure<br>b. Design of wheel rims<br>c. Methods of tire removal<br>d. Need for proper tire pressure                  |
| 6. Test an inner tube for leaks and cold patch   | a. How to locate air leaks in tube<br>b. Need of care in tube inflation   |



## 3 Organization of Instruction

### INSTRUCTIONAL MATERIAL AND DEVICES

AUTOMOTIVE INSTRUCTION appeals to many persons because it provides training in those experiences which face all citizens with respect to the upkeep and maintenance of an automobile.

What is taught in the Automotive Area is determined by the kinds of repair jobs the average automobile owner can do himself without special machinery and by what information he should possess to insure the intelligent use of the automobile and other gasoline-powered devices.

Take-home projects in this area of instruction are negligible because of the nature of the work. Emphasis in this activity is on *instruction* rather than on *construction*. An understanding of the method of procedure is needed for the pupil to perform most operations and jobs.

Listing the jobs to be performed in the Automotive Area so that they progress from the simple to the complex is difficult, since most of the jobs are independent of one another, and need not be taught in any particular order. All work should, however, be assigned so that each progressive job provides new techniques and skills which contribute to the attainment of the general and specific objectives of the activity.

#### Instruction Sheets

Success in teaching in the Automotive Area of the comprehensive general shop depends largely upon the proper planning of instruction and the development or purchase of instructional material which allows for individualized instruction.

Of the many successful types of instructional materials used in the Automotive Area, three sample sheets are illustrated in this bulletin:

THE INFORMATION ASSIGNMENT (Below).

THE JOB ASSIGNMENT (Page 15).

THE WORK RECORD (Page 16). This device is used by the pupil to record his findings when he uses the Information Assignment and the Job Assignment.

### **SAMPLE INFORMATION ASSIGNMENT**

#### **JOB:**

Remove only the valve covers on an 8-cylinder engine and find the order in which the valves open.

#### **REFERENCE:**

Kuns, Ray F., *Automotive Essentials*.—Page references are indicated with questions below.

#### **PRELIMINARY QUESTIONS:**

Write only the answers on the Work Record Sheet (See Page 16)

*Date Assigned* \_\_\_\_\_

- a. What is the firing order given for straight-8 engines? pp. 98-100 \_\_\_\_\_
- b. How many exhaust strokes occur during one revolution of an eight-cylinder engine? p. 85 \_\_\_\_\_
- c. Name the two valves of a cylinder which close and open almost at the same time. Name in order. p. 87 \_\_\_\_\_
- d. How many degrees does the flywheel revolve during the long pause in the movement of the valves? p. 87 \_\_\_\_\_
- e. What is the ratio of the number of teeth on the camshaft gear to the number on the crankshaft gear? p. 85 \_\_\_\_\_

On the Work Record (see p. 16) draw a circle 3 inches in diameter. Divide the circle into four equal parts.



## SAMPLE JOB ASSIGNMENT

### JOB:

Remove only the valve covers on an 8-cylinder engine and find the order in which the valves open.

### PROCEDURE:

1. List and secure the tools for the job: turning bar and chalk.
2. Remove only the parts called for in the job heading.
3. Examine the valve and tappet mechanism.
4. Divide the valves into pairs, beginning at the front, naming them "first pair," "second pair," etc.
5. Turn the engine clockwise and note which valve of each pair opens or compresses the spring first after the long pause. With the chalk, mark this valve *E* for "Exhaust." Do the same for one of each pair.
6. Check to see if the other valve of each pair opens immediately after the exhaust valve closes. Mark these valves *I* for "Intake."
7. Turn the engine clockwise until the exhaust valve (*E*) of the first pair starts to rise. Put a figure *1* on the Item 1 line of the Work Record (page 16). Turn engine slowly and note from which *pair* the next exhaust valve starts to open. Repeat until all exhaust valves have been marked.
8. Record only the answers on the numbered lines of the Work Record.
  1. *Order of opening of exhaust valves in figures beginning with 1.*
  2. *Order of opening of intake valves in figures beginning with 1.*
  3. *How many teeth on the flywheel?*
  4. *How many teeth must be turned from the time the exhaust valve of the first pair begins to open until the same valve closes and begins to open again?*
  5. *Place the direction arrow along the outside of the circle in the sketch.*
  6. *Place the proper firing order figures on the division marks of the circle.*
9. Have the job checked by your instructor.
10. If approved, wipe off all chalk marks. Clean all parts and tools. Turn in or replace the tools charged against your name.

## SAMPLE WORK RECORD

NAME \_\_\_\_\_ GRADE \_\_\_\_\_ ROOM \_\_\_\_\_

Student file copy \_\_\_\_\_

Student No. \_\_\_\_\_

Job No. \_\_\_\_\_

Name of the job \_\_\_\_\_

*Space for Drawing*

Date \_\_\_\_\_

ANSWERS TO THE INFORMATION QUESTIONS ON INFORMATION ASSIGNMENT  
(See p. 14)

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_

Date \_\_\_\_\_

ANSWERS TO THE SHOPWORK QUESTIONS ON JOB ASSIGNMENT (See No. 8,  
p. 15)

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. See drawing above \_\_\_\_\_
6. See drawing above \_\_\_\_\_

Use of Records and Charts

The Industrial Arts teacher of a comprehensive shop program is confronted with many problems pertaining to the administration of the program, the details of instruction, and the handling of supplies. The number of problems increases as the activities in the shop become more diversified. Development of adequate charts and the maintenance of accurate up-to-date records are important responsibilities of the Industrial Arts teacher. If properly developed, the keeping of records and charts will not be time-consuming and monotonous but will become an aid to the teacher in showing teacher-pupil progress, as well as an aid in the evaluation, development, and improvement of the instructional program. The teacher, however, should not become so involved with record keeping that he actually becomes a clerk. Instead, a plan can be devised whereby pupils and teacher share the work of recording progress and learning units.

PROGRESS CHART

The use of a student progress chart is of particular importance in the operation of the automotive activity. Since the activities taught are established through an analysis of jobs common to automobile repair and maintenance, and since these jobs may be unrelated and need not be taught in any particular order, it is essential that an

PROGRESS CHART										
Course						Semester		Year		
Grade										
Section										
Days										
Periods										
Pupils' Names	Information Units					JOBS				

Sample Progress Chart to Show Accomplishment of Pupils Throughout the School Year.

Grade 7 8 9 10 11 12 PG

City

given emphasis at this point because it is an effective device for achieving several of the common Industrial Arts objectives:

1. To develop attitudes of leading and following
2. To aid the teacher with the many routine duties
3. To aid in motivating the pupil's interest in understanding of industrial operations and applications

The shop management organization should be planned by the class. Because a teacher-imposed plan is readily recognized by the students and has a tendency to destroy student interest, better co-operation can be secured through a personnel plan developed by the pupils with teacher guidance and direction. Students may assist in the development of the plan as a class or through a committee of pupils from several classes. A plan developed in this manner motivates the pupils' interest in industrial personnel organization and provides incentive for study of local plant personnel systems. This is valuable in developing a well-organized plan for the school. Time spent in the democratic development of this plan is more than compensated by the cooperation attained and the guidance values received by the pupils. Suggestions for the development of a pupil personnel organization plan are given in *Industrial Arts in Pennsylvania*, Bulletin No. 331, page 83.

In order to make a pupil shop management plan operate successfully, the importance, need, and practicability must be explained carefully to the pupils. The success of the program depends entirely upon the pupils' acceptance; therefore, the teacher should plan his presentation carefully in order to justify in the minds of the pupils the value and need for such a program.

## PARTIAL CHECK LIST FOR CARE OF THE SHOP

The form below provides a partial check list for periodic teacher-evaluation of the condition of the shop, or it may be used by the student foreman in evaluating and checking on the work of the clean-up personnel.

	<i>Yes</i>	<i>No</i>
<b>TEACHER</b>		
1. A place for everything and everything in its place .....	_____	_____
2. Benches and machines well arranged .....	_____	_____
3. Tools and equipment in good repair .....	_____	_____
4. Bulletin board material well arranged and changed frequently .....	_____	_____
5. Teacher's desk orderly .....	_____	_____
6. A metal container for oily rags .....	_____	_____
7. Machines oiled regularly .....	_____	_____
<b>FOREMAN</b>		
1. Machines cleaned properly .....	_____	_____
2. Storage room well kept .....	_____	_____
3. Tools clean, in racks, and all accounted for .....	_____	_____
4. Blackboard clean .....	_____	_____
5. Finishing room clean and orderly .....	_____	_____
6. Floor cleaned daily .....	_____	_____
7. Books, pamphlets, blueprints clean and well arranged .....	_____	_____
8. Lockers kept properly .....	_____	_____
9. Projects stored in good order .....	_____	_____
10. Sink clean .....	_____	_____
11. Clean-up tools in proper place .....	_____	_____
12. All auto parts accounted for and in proper place .....	_____	_____



## 4 Instructional Aids

IN A BULLETIN OF THIS KIND it is impossible to list all instructional materials in the form of books, pamphlets, study guides, charts, etc. This listing is not exhaustive. Many instructors may be using excellent instructional aids not included here.

Certain instructional materials are listed, however, with author, publisher, address of publisher, and an annotation of the contents, so that the Industrial Arts teacher will know what phase of instruction is included in each reference.

### BOOKS

Crouse, William H., *Everyday Automobile Repairs*. New York City, McGraw-Hill Company, Inc., 1946. 296 pp., \$4.00.

Written in nontechnical language so that the average layman or student can understand the automobile. Proper maintenance procedures are detailed. Satisfactory for Industrial Arts work.

Crouse, William H., *Automotive Mechanics*. New York City, McGraw-Hill Book Company, Inc., 1946. 774 pp., \$6.50.

Detailed description of all phases of the automobile, including theory of operation, construction, maintenance and repair, and trouble shooting. This book is well organized for instructional purposes and well indexed for references. It is technical in nature but suitable for advanced pupils.

Dell, Truman G., Howard, Frank E., Stevenson, George E., *Basic Repair Operations for Automobile Mechanics*. Albany, New York, Delmar Publishers, 1949. 220 pp., \$3.75.

This book describes the repair operations which occur most frequently. Clearly written in nontechnical style and well illustrated.

Dell, Truman G., Howard, Frank E., Stevenson, George E., *Brake Work for Automobile Mechanics*. Albany, New York, Delmar Publishing Company, Inc., 1948. 194 pp., \$4.00.

Describes common types of brake systems and units, special brake tools, brake drum lathes, and other brake relining equipment. Supplementing this related information is a series of "How-to-Do" units. These cover: analyzing the brake job; disassembling and inspecting brake parts; the use of brake tools and accessories for truing, relining, and assembling brakes.



Major and minor brake adjustments, the bleeding of hydraulic systems, and the repair of cylinders are also treated. Brake adjusting and maintenance suggestions are also included. This manual, as its name implies, is a comprehensive treatment of brake work.

Frazee, Irving and others, *Automotive Fundamentals*. Chicago, Illinois, American Technical Society, 1949. 538 pp., \$4.90.

A comprehensive discussion on the fundamentals of all the units of the automobile. Well illustrated. This book would be satisfactory for advanced pupils.

Glenn, Harold T., *Exploring Auto Mechanics*. Peoria, Illinois, Charles A. Bennett Company, Inc. 317 pp., \$3.96

A survey of what makes an automobile operate, with sections on safe driving, purchasing of used cars, caring for the finish and upholstering of a car, and other items the average car owner should know. The book also contains a list of laboratory jobs.

Kuns, Ray F., and Plumridge, Tom C., *Automobile Engines*. Chicago, Illinois, American Technical Society, 1946. 731 pp., \$4.75.

Deals with the construction, maintenance, and repair of all types of engines, carburetors, cooling systems, and manifold systems.

Kuns, Ray F.—wrote the books listed below. These books, published by the Bruce Publishing Company of Milwaukee, Wisconsin, deal with the following courses of study in the Automotive Area:

*Auto Mechanics Course I, The Engine*. 272 pp., \$1.50

*Auto Mechanics Course II, Cooling Lubrication and Fuel Systems*. 256 pp., \$1.50

*Auto Mechanics Course III, Automotive Electricity*. 288 pp., \$1.50

*Auto Mechanics Course IV, Power Flow*. 312 pp., \$1.50

*Auto Mechanics Course V, Chassis Units*. 320 pp., \$1.50



## SERVICE MANUALS, CHARTS, AND BOOKLETS

Manufacturers of automobiles prepare service manuals for cars of every model. These manuals may be obtained from the local dealers or by writing to the home office of each manufacturer.

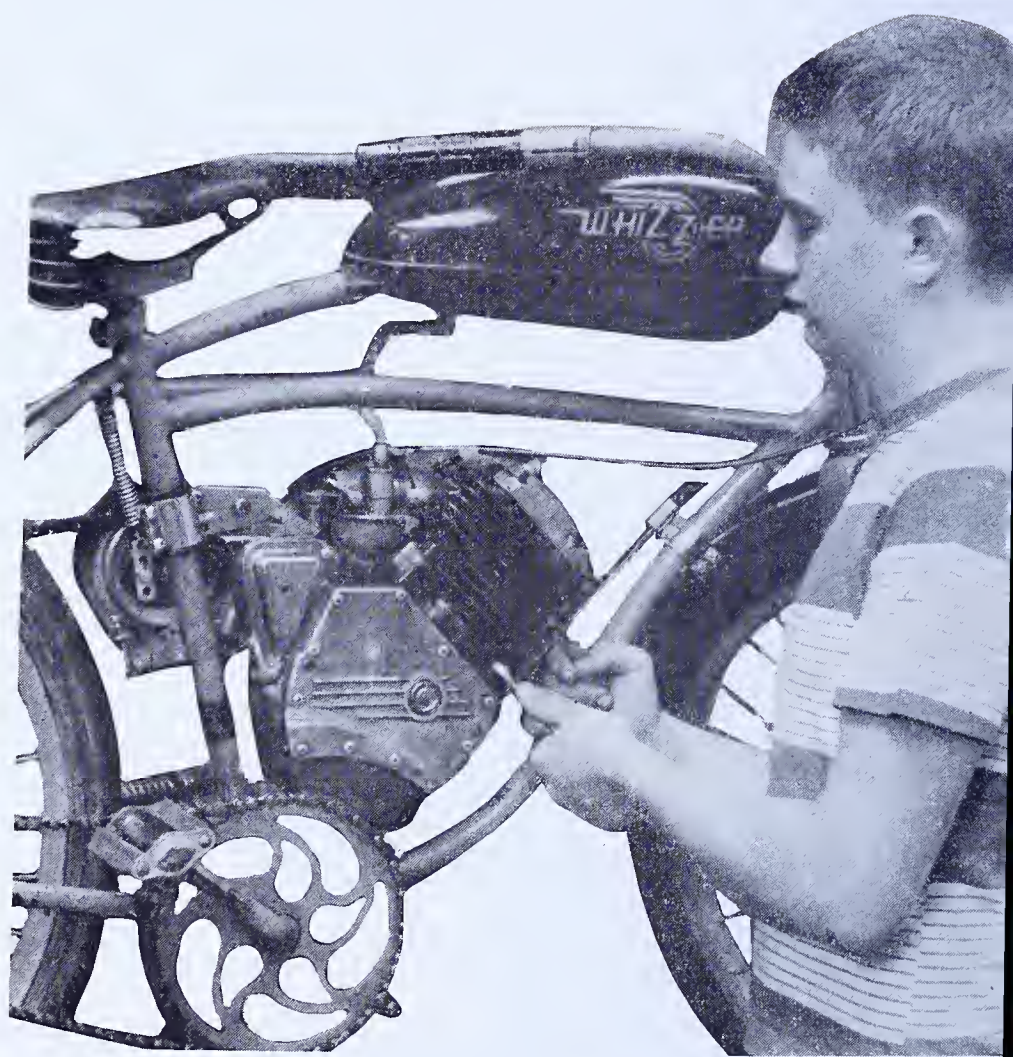
Manufacturers also publish many instructional aids in the form of charts, diagrams, and booklets, and supply them to schools free of charge. Some of these instructional devices are listed here:

*Standards for Automotive Service Instruction in Schools.* Detroit, Michigan, AI-VE Conference on Automotive Instruction, 320 New Center Building, 1951. 59 pp. No charge.

This publication lists the recommendations of the Automobile Industry-Vocational Education Conference on the program of automobile mechanics in the public schools. Gives valuable guidance information on student selection, the curriculum, supplies and equipment and many other suggestions on development of an auto mechanics course in schools.

\_\_\_\_\_, *ABC's of Hand Tools.* Detroit, Michigan, General Motors Corporation, 1943, 47 pp. No charge.





- Battery Service Manual.* 2706 Central Tower, Akron, Ohio, The Association of American Battery Manufacturers, 1946, 39 pp. No charge.
- Brake Service Guide.* Bridgeport, Connecticut, Raybestos Division, Raybestos-Manhattan, Incorporated, 1950. 64 pp. Price 25 cents.
- Brake System.* Detroit, Michigan, Pontiac Motor Division, General Motors Corporation, 1945, 152 pp. No charge.
- Factory Flat Rate Manual.* Revised annually. Motor, 572 Madison Avenue, New York 22, New York. \$6.00.
- Motor Age Flat Rate and Service Manual.* Revised annually. 56th and Chestnut Streets, Philadelphia, Pennsylvania, Chilton and Company. \$8.00.
- Socony Vacuum Oil Company, *Your Automobile, How to Understand It.* 26 Broadway, New York 4, New York. Price \$1.00.
- Training Charts, *The Ignition System.* Anderson, Indiana, Delco-Remy Division, General Motors Corporation, 1950. \$4.00.

### MAGAZINES<sup>1</sup>

- Automobile Digest.* 22 East Twelfth Street, Cincinnati 10, Ohio, Automobile Digest Publishing Corporation. Annual subscription, \$3.00.
- Hot Rod Magazine.* 1015 South La Cienega, Los Angeles 35, California, Motor Trend Publications, Incorporated. Annual subscription, \$3.00.
- Motor.* Hearst Magazine Incorporation, 250 West Fifty-fifth Street, New York 19, N. Y. Annual subscription, \$4.00.
- Speed Age.* Speed Age, Incorporated, Professional Building, Hyattsville, Md. Annual subscription, \$3.00.

### FILM SOURCES AND TITLES

The following sound films are available from the State Teachers Colleges located at Bloomsburg, California, Edinboro, Indiana, Lock Haven, Millersville, Slippery Rock, and West Chester:

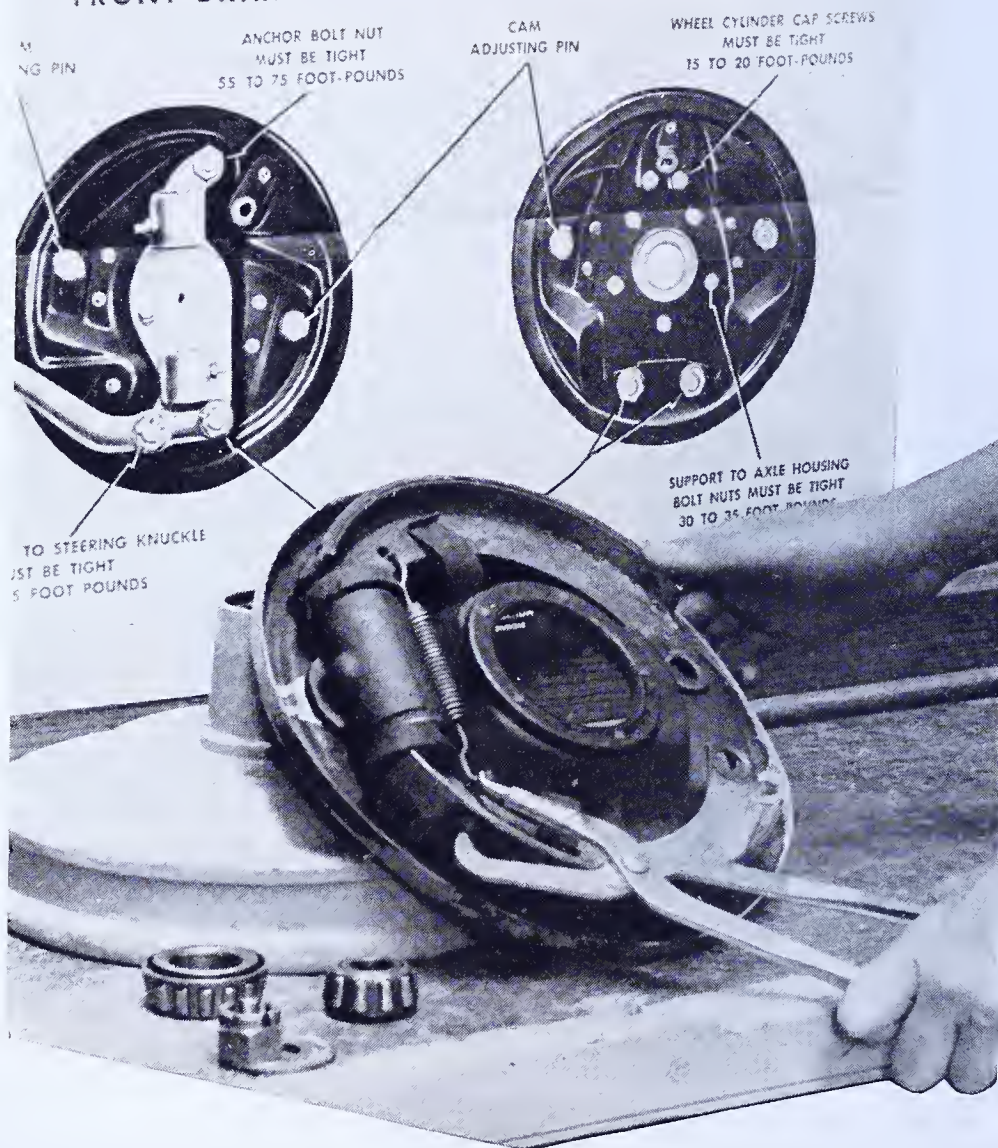
- PRI-1A Battery, Ignition, and Electrical System, The
- PRI-2A Clutch and Hand Brake, The
- PRI-3A Cooling System and Fuel System, The
- PRI-4A Engine Assembly, The
- PRI-5A Engine Tests and Tune Up
- PRI-6A Hydraulic System, The
- PRI-7A Introduction to Preventive Maintenance
- PRI-8A Steering, Wheels, Front and Rear Axles
- PRI-9A Transmission, Drive Shaft, and Differential

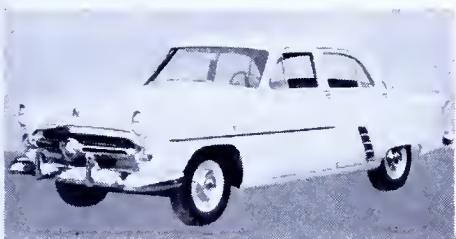
<sup>1</sup> Monthly Publications.



## FRONT BRAKE

## REAR BRAKE





## *5 Equipment and Supplies*

### **MACHINERY AND SUPPLY LISTS**

THE AUTOMOTIVE AREA has an advantage over other units in that the equipment (not tools) needed can be had for a nominal sum. With ingenuity and resourcefulness the teacher can set up the Automotive Area so that it will be attractive and functional. Most of his equipment will come from the used-car lot or the auto-wrecking yards.

Because of the normally short shop periods, the teacher must have the shop equipment and the work well organized if he is to get the most from this Industrial Arts shop area. The engines should be cleaned, painted in bright colors, and mounted on substantial stands. Mock-ups must be well designed and should be set up before the opening day of school.

In order to select the tools and equipment properly the teacher must first carefully plan the work of the pupils during the course. The type of engines or other component parts to be used for instruction must be determined so that the proper tools for those particular items can be selected. Normally there will be very little need for duplication of equipment since the work should be so organized that pupils will be assigned a variety of jobs requiring different tools.

Tools selected should be standard equipment of good quality. Properly used and cared for, these tools will serve for many years.

A careful selection should be made of component parts of the automobile to be used in instruction. Although the theory involved can be taught on parts 5, 10, or 15 years old, it is preferable to teach it on

modern equipment. Frequent technological changes have been and will continue to be made; therefore, the instructor needs to keep as nearly abreast of the times as possible. It is recommended that no installation of equipment which is over five years old be made and that replacements be made at intervals to keep all equipment within that time limit.

## **How to Select Equipment and Supplies**

The Industrial Arts teacher is frequently called on to recommend replacements for worn-out equipment, hand tools, and supplies, or is consulted as to the purchase of new equipment for the shop. No two schools have the same budget, physical plant, or educational program; therefore, all planning of tools, equipment, and supply needs must be made to fit local needs and resources.

Some questions with regard to specific factors to be considered in selecting the quantity and the type of equipment are:

1. Does the equipment have definite application in carrying out the objectives, scope, and content of the course of study?
2. Will the shop serve junior high, senior high, or both groups?
3. What activities will be taught?
4. Is the size of the class proportionate to the physical plant?
5. What funds are available?
6. Is the equipment suitable for the space available?
7. Is the equipment of modern design and can it be easily maintained?
8. Does the equipment have adequate safety devices?
9. Is the equipment mechanically designed for safety under ordinary operating conditions?
10. Is the equipment flexible? Can it be adapted to other uses?
11. Has the electric power supply been taken into consideration in selecting equipment?

## **How to Specify and Order Equipment**

When purchasing equipment and supplies it is essential that complete written specifications be prepared to submit to distributors for bids. Upon request to manufacturers, shop instructors will be furnished with catalogs of hand tools, power tools, and other equipment. These catalogs contain complete descriptions of each item and a catalog number identification. Most distributors use the same descriptions and numbers as those in the manufacturer's catalog.

Each item on the specification or order sheet must be accompanied

by all necessary information. Items should be listed in a uniform manner with the following information:

- |                     |                                 |
|---------------------|---------------------------------|
| 1. Item number      | 4. Catalog number               |
| 2. Quantity desired | 5. Name of item                 |
| 3. Unit of measure  | 6. Complete description of item |

Specifications should ordinarily be written to cover a specific piece of equipment which meets the teacher's requirements. In setting up such specifications, write the words *or equal* following the item or include it in the "Instructions to Bidders."

Many pieces of equipment needed for the Automotive Area cannot be secured through normal purchase procedures—particularly the various units of the automobile. The instructor will have no difficulty in securing such items as engines, transmissions, and steering units from his local garage or used-parts dealers. Such items may often be obtained without cost to the school.

### How to Prepare a Requisition

When making purchases of tools and supplies for the Automotive Area complete written specifications should be prepared as for all other types of shop tools and equipment. Catalog descriptions of tools should be followed closely in preparing a requisition as shown in the illustration below:

Quantity	Item	Unit Price	Total
1 set	Wrenches, end; double broached hexagonal, double offset, forged chrome-molybdenum alloy steel. <div> <div>Sizes:</div> <div> <math>\frac{3}{8}</math>" and <math>\frac{7}{16}</math>"  <math>\frac{1}{2}</math>" and <math>\frac{9}{16}</math>"  <math>\frac{7}{16}</math>" and <math>\frac{5}{8}</math>"  <math>\frac{11}{16}</math>" and <math>\frac{13}{16}</math>"  <math>\frac{3}{4}</math>" and <math>\frac{7}{8}</math>"  <math>\frac{15}{16}</math>" and 1" </div> </div>		

The teacher will have difficulty in writing specifications for such items as engines and carburetors, since most of this material will be purchased from used-car lots or auto-wrecking concerns. It is recommended that he be given the authority to inspect and purchase this equipment without the requirement of writing specifications for it. This will enable the teacher to select the type of equipment desired, to check its condition, and to see that all necessary parts are available, in order to have a complete instructional unit.





## **Storage and Control of Tools and Supplies**

Proper arrangement of tools depends largely on the shop layout, type of activities, size of the class, money available, and the ease with which the tools can be checked at the end of the shop period.

The present trend is to substitute the open tool panel for the traditional toolroom. The tool panel either is fastened to a wall or is movable, and contains tools normally used in the particular work area. The panel is painted with a bright background, with each tool silhouetted in a darker paint. This method of tool storage is recommended because of the simplicity of its administration, time saved in obtaining and returning tools, ease in checking tools, and improved appearance of the shop area. Additional suggestions on tool control may be found in Bulletin 331, *Industrial Arts in Pennsylvania*, pages 91-93.

## **How to Keep a Shop Inventory**

Maintaining an inventory of equipment and supplies is a necessary administrative procedure of the general shop teacher. The many items which the instructor must order, store, and issue require the best accounting methods.

Because there can be little or no substitution of parts, materials, or tools when working on automobiles, it is even more important that the shop instructor maintain in the Automotive Area an effective system of accounting for these items.

The inventory sheet shown on page 32 was developed primarily for an annual inventory but it can be used also for monthly or bimonthly check on materials for the Automotive Area.

INVENTORY OF AUTOMOTIVE AREA

<i>Received</i>	<i>EXPENDED</i>				<i>On Hand at End of Term—1951-52</i>	<i>To Be Ordered</i>
	<i>Broken</i>	<i>Worn Out</i>	<i>Lost</i>	<i>Transferred</i>		
2			1	1	0	2
1		1			0	1
3	1				2	1

\_\_\_\_\_ HIGH SCHOOL  
\_\_\_\_\_ SCHOOL DISTRICT

INVENTORY OF  
AUTOMOTIVE AREA

INSTRUCTOR \_\_\_\_\_

SCHOOL YEAR \_\_\_\_\_

<i>Description of Items</i>	<i>Unit Cost</i>	<i>Total Cost</i>
WRENCH, ratchet, 10" x 1/2" alloy steel		
SYRINGE, rubber, for adding battery water		
CREEPER, metal or wood, 4 universal casters		



## TOOL, MACHINERY, AND OTHER EQUIPMENT LIST

### Hand Tools

The hand tools needed in an Automotive Area are numerous, since this is a service activity. Tools selected should be sturdy, simple, and practical. They should be of the type used currently. Particular attention should be given to the alloy content, heat treatment, and guarantee. Prices are those of January, 1953.

1	Brake adjusting tool, for star nuts .....	\$1.15
Gauges		
1	shoe and drum, leaf-type shim gauge for checking brake shoe and drum clearances .....	1.30
1	spark plug, 8 wires .....	1.25
1	tire pressure—standard tire pressure gauge, 0-60 lbs. capacity .....	1.05
2	thickness— $2\frac{5}{16}$ " length blade, 22 blades .004" to .025"; tempered and encased .....	4.10
Hammers		
2	machinist, 12 oz. ball peen, forged steel, heat-treated, and polished, wooden handle .....	2.90
2	machinist, 24 oz. ball peen, forged steel, heat-treated, wooden handle .....	4.30
2	soft-face, brass or plastic head, wooden handle, 2 lb. ....	7.10
2	Oilers, 5 oz. 4" spout steel can; tempered steel bottom .....	.90
Pliers		
1	5" needle nose, cross-checked, spring-tempered nose, forged tool steel .....	2.60
1	8" combination slip joint, forged tool steel .....	2.20
1	7" diagonal cutter mechanic's pliers; forged heat-treated, high-grade tool steel .....	3.00
Punch and Chisel Set		
1	forged alloy steel; hammer-tested; assorted 8 to 12 pieces .....	8.50
Screw Drivers		
2	$\frac{1}{4}$ " x 4" carbon steel blade, plastic handle .....	2.10
2	$\frac{5}{16}$ " x 6" carbon steel blade, $\frac{5}{16}$ " dia., plastic handle .....	2.70
1	$\frac{5}{16}$ " x 10" square drop forged-steel blade, plastic handle .....	1.50
1	offset at both ends, forged and tempered tool steel .....	.70
1	$\frac{1}{2}$ " drive, drag link socket .....	1.15
1	Rule, steel	
	12" x 1" width stainless steel; tempered. Graduated in $\frac{1}{8}$ ", $\frac{1}{16}$ ", $\frac{1}{32}$ ", $\frac{1}{64}$ " .....	.75
1	Screw Extractor	
	set of five pieces .....	1.75
1	Soldering Copper	
	electric, $\frac{5}{8}$ " electric soldering copper, 200 watt; complete with cord, tip, and stand .....	11.80

1	Stud Remover 1/4" to 5/8" wedge-type; 1/2" drive .....	3.35
Wrenches		
2	adjustable, 6" single and adjustable jaw; forged steel, replaceable parts .....	3.00
1	adjustable, 10" single and adjustable jaw; forged steel, replaceable parts .....	2.75
1	set double-broached hexagon, double offset drop forged chrome-molybdenum alloy steel. Lifetime guarantee and replaceable, 6 pieces. Long length, boxed	
	3/8" and 7/16" .....	11/16" and 13/16"
	1/2" and 9/16" .....	3/4" and 7/8"
	9/16" and 5/8" .....	15/16" and 1"
		10.40
1	set electrical, open end, double end, thin chrome-molybdenum alloy forged steel, chrome-plated, electrical set of nine, 13/64" to 5/16" openings .....	6.05
1	extension drive, 5"-1/2" extension drive; alloy steel; lock-in plug connector .....	1.50
2	handle, 11"-1/2" sliding "T" handle; alloy steel; lock-in plug connector .....	4.60
1	pipe, 10" length, 1/8" to 1" capacity; forged and hardened tool steel	2.10
1	ratchet (reversible) 10"-1/2" alloy steel with high-grade ratchet gear; quick reversible; lock-in plug connector .....	6.25
2	sets sockets, 1/2" square drive, thin wall, double-broached; chrome alloy heat-treated sockets; chrome-plated finish; lifetime guarantee and replaceable	
	7/16" .....	5/8"
	1/2" .....	21/32"
	9/16" .....	11/16"
	9/16" extra thin for Ford V-8, 85 Hp connecting rods .....	3/4"
	19/32" .....	25/32"
		13/16"
		13.20
Tappets, adjusting		
2	1/2"-9/16" open end, thin, alloy steel .....	2.70
2	5/8"-11/16" open end, thin, alloy steel .....	3.00
Vises		
1	machinist, 4" jaw, swivel base .....	11.00
2	machinist, 4" jaws, solid base .....	37.90
Total .....		\$170.60

List of Special Tools and Testing Devices

Most of the equipment used in the automotive area shop will last a long time, including such items as compressors, grinders, welding torches, and creepers.

Testing devices are more fragile and consequently more expendable. They must be replaced or repaired regularly to be useful. It is important that the meters, analyzers, and testers be of the type used currently in industry. The advice of local service people will be of great assistance when considering types to be procured.

Battery

1	hydrometer, with built-in thermometer. Syringe action .....	\$1.45
1	storage, automobile, 6 volt, 13 plate, 100 amp. hour capacity ...	11.77
1	syringe, rubber, for adding distilled water to cells .....	.59
1	water container, nonmetallic for distilled water .....	6.25
1	voltmeter, high-rate discharge 0-3V, high capacity resistance unit, prong type .....	19.75

Cans

1	safety gasoline. 1 gallon, 24-gauge, lead-coated; nonspill sealed; trigger-type pouring lip; Underwriters approved .....	1.58
1	waste, galvanized 12" x 15" can with legs and spring-lift cover .....	4.50

Creeper

1	metal or wood, 4 universal casters attached for easy movement ...	8.95
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Radiator Hydrometer

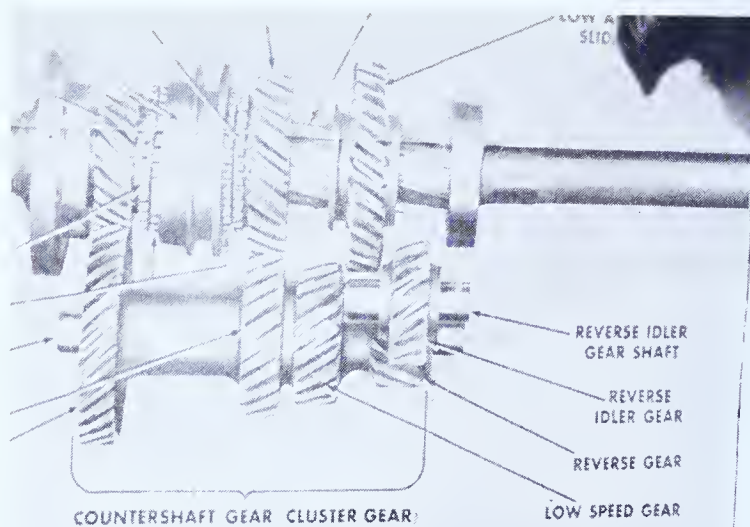
1	calibrated for alcohol, glycerine, and prestone; with built-in thermometer .....	7.90
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Thermometer

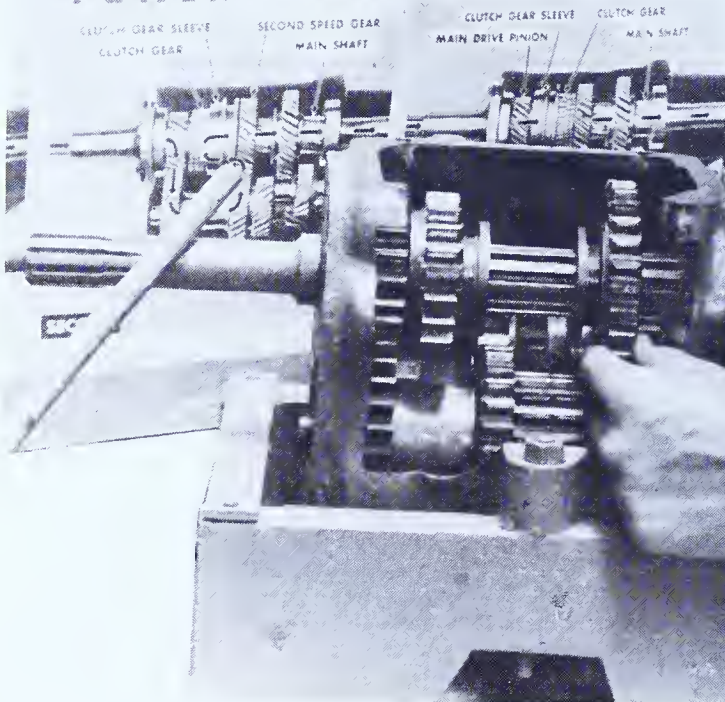
1	Fahrenheit scale, glass-tube mercury thermometer; scale 0° to 300°F; complete with glass, molded eyelet, and sturdy case .....	2.25
---	--	------

\$64.99





## POWER FLOW



**Lists of Parts, Educational Units, and Mock-ups**

2	Brake Assemblies; complete assembly including wheel brake cylinder, linkage, and foot pedal for basic instructional unit on brakes. (Order hydraulic, disc, etc. types which are used on current model cars.)	\$30.00
3	Carburetors: current models used on popular model automobile engines	\$3.00
2	Differentials: complete with carrier, axles, and power drive. Hotchkiss-Drive types—for assembly and disassembly	\$35.00
3	Distributors: order distributors which are currently used on all popular automobile engines. Complete with distributor head, points, condenser, vacuum advance, automatic advance, and lubrication fitting—for use as basic training elements	\$1.00

**Engines**

1	6-cylinder, overhead valve engine complete with clutch and transmission, ignition, and fuel systems—to be in operating condition	\$50.00
1	Single-cylinder, four-cycle, air-cooled engine, such as is commonly used on lawn mowers, washing machines, and other home power equipment	\$25.00
1	Single- or twin-cylinder, two-cycle, water- or air-cooled engine, such as is commonly used on marine units or home power equipment..	\$25.00
2	Engines, used, for assembly purposes. To be mounted for dead engine work. One L and one V type with carburetors, distributors, starters, and generators	\$50.00
3	Fuel Pumps: used on current model automobile engines—vacuum, mechanical, magnetic, etc.	\$6.00

**Ignition**

3	Coils used on current model automobile engines—for basic training elements	\$3.00
3	Condensers, used on current model automobile engines—for basic training elements	\$1.00
1	Wiring Panel: 4' x 4' x 3/4" Plywood panel mounted on sturdy up-rights	\$6.00
		<hr/> \$235.00

## CONSUMABLE SUPPLY LIST

The supplies must be considered expendable. The items should be stocked in sufficient quantities to permit efficient day-to-day operation. Although the supply list may seem lengthy, the quantity expended per student hour will be very low in comparison with many other types of classes.

The secret to efficient utilization of supplies hinges on supply storage. If supplies are carefully stored away, disbursed properly, and regularly inventoried, the supply problem is solved.

1	Air Hose, 25' length, 1/4" I.D., 5-ply, red, complete with 1/4" pipe thread fittings .....	\$4.50
	Battery	
4	bolts, 5/16" x 1 1/2" U.S.S. lead-coated battery terminal bolts complete with nuts .....	.32
4	clips, cadmium plated, 24¢ each .....	.96
2	Brushes, 1 1/2" flat, 49¢ each .....	.98
	Bulbs	
2	lamp auto, No. 65 single contact, 5 candle power, 6-8 volt, 10¢ each .....	.20
3	lamp auto, No. 24 double contact, 3 candle power, 6-8 volt, 32¢ each .....	.96
2	lamp auto, No. 115 double contact, 21 candle power, 6-8 volt, 27¢ each .....	.54
2	lamp auto, No. 2320 double filament pre-focused, 32 candle power, 6 volt, 43¢ each .....	.86
	Cables	
50 ft.	primary, single conductor, stranded copper braid and lacquer-covered, 14 gauge, 7¢ per foot .....	45.00
2	starter, No. 1 gauge rubber and woven cover insulation, 2 pieces 4 ft. long with terminals, \$11.30 each .....	22.60
25	terminals, AS-SOS-11 solderless, 4¢ each .....	1.00
25	terminals, 3/16" hole, primary, 4¢ each .....	1.00
25	terminals, 3/16" spade type, primary, 4¢ each .....	1.00
	Cotter Pins	
1	box of 1000 1/16" x 3/4" .....	.65
1	box of 1000 3/32" x 1" .....	1.00
1	box of 1000 1/8" x 1 1/2" .....	2.15
2	Files: ignition point, 15¢ each .....	.30
24	Fuses: automobile No. 3 AG, 20 amp., 5¢ each .....	1.20
12	Hose Clamps: universal type, to fit 1" to 3" O.D. Hose, 9¢ each .....	1.18
1 qt.	Hydraulic Brake Fluid .....	1.85

# Sockets

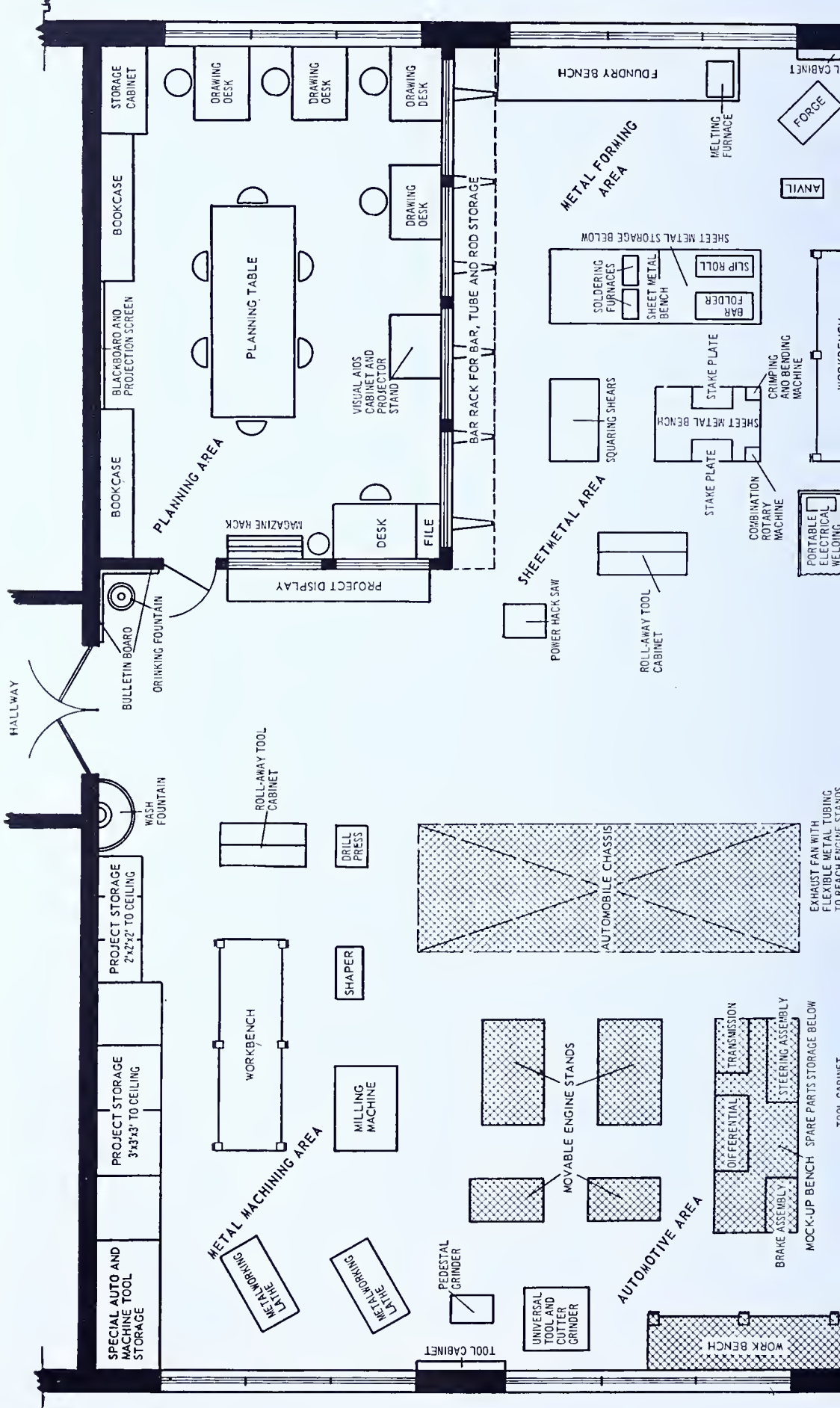
6	dash light, double contact, 6 volt .....	2.40
6	dash light, single contact, 6 volt .....	2.40

# Solder

2	lb. wire, No. 5 spools, 1/8" diameter, 50-50 alloy, \$1.21 lb. ....	2.42
1	lb. paste, all purpose, noncorrosive .....	

# Tape

2	rolls 3/4" friction, 8-oz., 40¢ per roll ..	.80
2	rolls 3/4" rubber .....	.60
2	Tire Repair Kits: garage size, red, 450 sq. in. 1/4 pint cement, \$2.00 each .....	4.00
5	lb. Wire, bonding: annealed iron, stove pipe, No. 16 .....	1.48
		<hr/> 102.35







## *6 Shop Layout*

### THE PHYSICAL SETUP

A SUGGESTED SHOP LAYOUT for the Automotive Area in a comprehensive general shop is illustrated on page 40. In this instance, the Automotive Area (see shaded areas on the plan) appears with Metal Machining, Sheet Metal, Metal Forming, and Planning areas. The total shop area is 2232 square feet; the automotive shop is approximately 616 feet square.

Equipment for the Automotive Area consists of a mock-up bench containing differential, transmission, brake assembly, and steering assembly; four movable engine stands; work bench and tool cabinet. Rollaway tool cabinets may provide other tool storage.

The plan indicates space for an automobile chassis. The area is equipped with an exhaust fan with flexible metal tubing to reach the engine stands. A 12 x 20-foot concrete apron outside the 12-foot overhead door provides space for bringing automobiles into the shop area. Space is provided in the shop for a live automobile.

Note that the machines of other activities are easily accessible to the Automotive Area.



## NOTES